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| 09/651,386      | 08/29/2000  | ZHIPING YIN          | 11675.165.2         | 9675             |

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EXAMINER

QUACH, TUAN N

ART UNIT PAPER NUMBER

2814

DATE MAILED: 07/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/651,386

Applicant(s)

YIN ET AL.

Examiner

Tuan Quach

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 17 April 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-18 and 20-28 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 20-28 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is unclear as to which claim claim 5 depends from. To the extent it depends from claim 2 or 24, there is no antecedent basis for the heating step of the first dielectric layer.

Claims 15, 17, 18, 20-22, are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The step of heating the first dielectric layer to a first temperature and thereafter heating the first dielectric layer to a second temperature . . . , e.g., in amended portions of claims 15, 17, 18 is not described in the original disclosure.

This application presents a claim for subject matter not originally claimed or embraced in the statement of the invention. See the subject matter delineated above regarding the first and second temperature as delineated above. A supplemental oath or declaration is required under 37 CFR 1.67. The new oath or declaration must properly identify the application of which it is to form a part, preferably by application number and filing date in the body of the oath or declaration. See MPEP §§ 602.01 and 602.02.

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The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-14, 16, 24-27 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-46 of U.S. Patent No. 6,150,257. Although the conflicting claims are not identical, they are not patentably distinct from each other because the claimed features of the instant claims are encompassed in the claims of '257 including respective dependent claims with the instant claims are broadened in scope, e.g., electrical device instead of semiconductor device in claims 1 and 6, heating rather than heating at less than in claim 2 versus claim 4 of '257, the passivation including chemical reaction products and solid solutions mixture in claim 10 corresponding to the passivation claimed in '257 by reacting with the chemical position, the process including titanium liner, titanium nitride and tungsten plug or metallic structure and the passivation layer of tungsten nitride in claims 16, 24, 25 corresponds to the process claimed in claim 42 of '257 with broader scope, claims 26 and 27 regarding nitrogen-containing silane correspond to well known alternative compositions to ammonia for nitrogen source such as ammonia, diatomic nitrogen,

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nitrogen containing silane and the like, as admitted on page 6 lines 12-15, such selection of well known alternative materials thus would have been obvious and would have been within the purview of one skilled in the art. The features of 1 to 1000 atomic lattice layers being reacted would have been obvious over '257, e.g., as in claims 1, 6, 9-13, 32-33, 40-42, 44, etc. wherein an overlapping range of at least one monolayer to be reacted was taught.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 2, 5-14, 24-27 rejected under 35 U.S.C. 103(a) as being unpatentable over Iijima et al. taken with Hu.

Iijima et al. teach providing opening in insulating film 32, filling with conductive films 33/34/35, removing portions of the conductive films outside the opening to form

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conductive plug in the opening, annealing in nitrogen atmosphere to nitrify the surface of layer 35. As this corresponds to metal nitride material thus it would also correspond to the passivating layer. In addition, such nitridated layer thus would protect the surface of the upper surface wherein the upper surface is covered with such nitride layer thus protected thereby. The provision of upper insulating layer 37 thus adhered to the top surface thereunder is also shown. See column 7 line 63 to column 8 line 43, column 10 lines 10-14 and 29-43. An alternative process employs forming opening in insulating layer 82, depositing conductive layer 84, forming plug filling the opening, annealing in nitrogen to form layer 84b, depositing second insulating layer thereon. See column 15 lines 30-64. The limitation regarding the dielectric layer adhered to the conductive layer and the passivation layer by chemical reaction or including chemical reactions and/or solid solutions would be met, absent evidence to the contrary, and as shown in Iijima et al. and any reaction between the dielectric and the nitriding layer would take place due to the proximity of the layers. Furthermore, Hu teaches the inclusion of tungsten nitride barrier 12 on tungsten plug 14 in an insulating layer wherein the tungsten nitride can be formed by light nitridation of tungsten including the plasma nitridation, e.g., in environment containing nitrogen and plasma thereof to form effective diffusion barrier. See Fig. 1, column 2 lines 13-28, column 3 lines 5-8, column 7 line 65 to column 8 line 18. The nitride obtained thus serves as the passivating layer covering the tungsten and thus protecting the surface thereof as well. In addition to the reasons delineated in Iijima et al. above, it would have been further obvious to have effected the light nitridation of the conductive plug in Iijima et al. wherein effective barrier thereon would

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be obtained as suggested by Hu. It would have been conventional and would have been within the purview of one skilled in the art to have selected appropriate and suitable layer thicknesses, and conventional nitrogen containing plasma such as ammonia; claims 26 and 27 regarding nitrogen-containing silane correspond to well known alternative compositions to ammonia for nitrogen source such as ammonia, diatomic nitrogen, nitrogen containing silane and the like, as admitted on page 6 lines 12-15, such selection of well known alternative materials thus would have been obvious and would have been within the purview of one skilled in the art. Regarding the features of 1 to 1000 atomic lattice layers being reacted, such would be met by the references as delineated above, given that the nitridation is effected therein in Iijima et al. and Hu, absent evidence to the contrary that the nitridation therein would need be over 1000 atomic lattice layers, given that the Office is not equipped to determine the number of atomic lattice layers being reacted and the thickness encompassed.

Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iijima et al. taken with Hu as applied to claims 1, 2, 5-14, 24-27 above, and further in view of Aoyama et al.

The references as applied above do not recite in-situ deposition.

Aoyama et al. teach the use of apparatus allowing the processing including plasma nitridation and interlayer insulator deposition without exposure of the wafers to the atmosphere. See Fig. 35, column 29 line 36 to column 30 line 13.

It would have been obvious and would have been within the purview of one skilled in the art to have effected the processing above including in-situ deposition of the

upper insulating layer in a desired processing sequence together with or immediately following the formation of the nitride film without exposure to the atmosphere since such is conventional and advantageous to avoid interaction between the atmosphere and the previously formed film.

Applicant's arguments filed April 17, 2003 have been fully considered but they are not persuasive.

Initially, with regard to the issue of the first and second temperature, see the reasons delineated above. Regarding the 1 to 1000 atomic lattice layers such would have been encompassed in Hu and Iijima et al. which employ surface nitridation and light nitridation by reacting with nitrogen. It remains that as the nitridation of the surface of the conductive surface is effected, the above range would be met or otherwise obvious, absent evidence to the contrary. The nitride layer formed over the surface of the conductive material thus would correspond to the passivating layer, instant specification page 5 lines 23-26. It remains that such passivating layer would correspond to the layers obtained in Iiyama et al. and in Hu wherein the metal nitride is also obtained. Such layer thus would protect the surface of the upper surface wherein the upper surface is covered with such nitride layer thus protected thereby. It remains that such inclusion of the nitride layer is well known and advantageous as evidenced by Iiyama et al. and Hu. Applicant further argues that the barrier thickness disclosed in Hu is 100 nm. Nonetheless, Hu is not limited to 100 nm barrier thickness and encompasses such thickness optimization that is well within the purview of one skilled in the art. See further Hong et al., column 4 line 1. Applicant also fails to show the criticality of such



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thickness and in any event, the failure of applicant to incorporate such thickness in the claims clearly evidence the non-criticality of such thickness.

Applicant argues that Iijima et al. does not teach the passivation sufficiently thicken to resist formation of the oxide husk yet does not prevent the second dielectric layer from adhering to the second conductive layer and that additional steps not required in the instant applications would be required. Applicant nonetheless has failed to show that the adhesion of the dielectric to the conductive layer would not take place in Iijima et al. and that the chemical reactions would not take place due to the proximity between the dielectric layer and the nitriding layer. It remains that such layers would be apparent due to the proximity thereof. In addition, the light nitridation in Iijima would have been obvious and advantageous as evidenced by Hu et al. wherein effective barrier would be obtained.

Applicant argues that Hu employs a different order by building a stack that is later exposed, instead of forming a depression. This does not consider the teaching of tungsten 14 in insulating layer and the formation of tungsten nitride layer on the plug. It remains further apparent that such opening formation and filling with conductive plug therein is well known in the art and does not require any inventiveness. The provision of the opening in an insulating layer 82 followed by conductive layer 84 to form plug and annealing in nitrogen is also shown in Iijima et al., see column 15 lines 30-64.

Applicant argued that the thickness of less than 50 Å or 2 to 20 Å is not explicitly recited. To the extent that such thickness is critical they should be incorporated into the claims, particularly claims 1, 10, and 16 which are silent regarding any thickness of the

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resulting nitride. The selection of such non-critical thickness would have been one that is normally within the purview of one skilled in the art and would have been a matter of routine experimentation and optimization.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is 703-308-1096. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (703) 308-4918. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9318 (Before Final) and (703) 872-9319 (After Final).

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

A handwritten signature in black ink, appearing to read 'Th' with a long horizontal stroke extending to the right.

Tuan Quach  
Primary Examiner